# SILVER ALLOY FOR REFLECTION FILM FOR OPTICAL RECORDING DISK

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Abstract of **JP 2002319185 (A)**

PROBLEM TO BE SOLVED: To provide a silver alloy for a reflection film having high thermal conductivity and suitable for an optical recording disk dealing with high recording density, by which high data reliability can be secured. SOLUTION: The silver alloy consists essentially of Ag and contains at least one first added element of 0.001-0.1 wt.% selected from the group consisting of Cr, Zr, La, Ce, Eu, Ca, Sr, Ba, Ru, Ni and W. In the silver alloy for the reflection film, at least one second added element of 0.1-5 wt.% selected from the group consisting of Zn, Mg, Au and Pd can be added to the first added element.

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[Claim(s)]
[Claim 1]A silver alloy for optical recording disk reflection films which makes Ag a principal component and is characterized by the remainder consisting of inevitable impurities including Cr, Zr, La, Ce, Eu, Ca, Sr, Ba, Ru, nickel, and at least one sort of alloying elements chosen from a group which consists of W 0.001 to 0.1weight %.
[Claim 2]The silver alloy for optical recording disk reflection films according to claim 1 by which at least one sort of 2nd alloying elements chosen from a group which consists of Zn, Mg, Au, and Pd being included 0.1 to 5weight % in addition to said alloying element.

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the silver alloy used as a reflection film of various optical recording disks.
[0002]
[Description of the Prior Art]As a medium which records computer information, video information, or music information, various optical recording disks (henceforth an optical disc), such as CD, CD-R, CD-RW, DVD, DVD-RW, DVD-RAM, MOD, and MD, are used.
[0003]As for these optical discs, the thin film which uses as a substrate a transparent disk [ like polycarbonate ] made from plastics whose all are although structures differ, respectively, and has various functions, such as a reflection film and an overcoat, on it is formed in layers by the method.
[0004]The reflection film of this optical disc has functions, such as missing the heat resulting from a laser beam with the function to reflect the laser beam used for reading and writing of record.
It is used for any optical disc of the method.

As the quality of the material of this reflection film, aluminum, Au, Ag(s), or these alloys are mainly used.

[0005]These reflection films are formed by the usual sputtering method etc. using the target which consists of aluminum, Au, Ag(s), or these alloys.

[0006]

[Problem to be solved by the invention]In recent years, the storage density of an optical disc follows on improving, and the demand of a thermally conductive high reflection film is increasing. However, about the reflection film of aluminum, it is clear from the point that thermal conductivity is low that demand characteristics cannot be satisfied. Although the reflection film of Au has a possibility that the demand characteristics about high-heat-conductivity nature can be satisfied, since the price is very high, it is difficult to use for a commercial optical disc.

[0007]On the other hand, about the reflection film of Ag, although thermal conductivity is satisfied, it has the problem of deterioration of the characteristics by rewriting of data, the storage under a high-humidity/temperature environment, etc. being large, and being hard to secure the reliability of data. For this reason, the reflection film with which it is completely satisfied of thermally conductive demand characteristics simultaneously is not obtained, securing the reliability of data.

[0008]Securing the reliability of high data in view of this conventional situation, this invention has high thermal conductivity simultaneously, and an object of this invention is to provide the silver alloy for reflection films suitable as an object for optical discs corresponding to high storage density.

[0009]

[Means for solving problem]In order to attain the above-mentioned purpose, [ the silver alloy for reflection films of the optical recording disk which this invention provides ] Ag is made into a principal component and the remainder consists of inevitable impurities, including Cr, Zr, La, Ce, Eu, Ca, Sr, Ba, Ru, nickel, and at least one sort of alloying elements chosen from the group which consists of W 0.001 to 0.1weight %.

[0010]In addition to said alloying element, in the silver alloy for optical recording disk reflection films of above-mentioned this invention, at least one sort of 2nd alloying elements chosen from the group which consists of Zn, Mg, Au, and Pd can be included 0.1 to 5weight %.

[0011]

[Mode for carrying out the invention]As a result of examining various causes that the reflection film of the optical disc which consists of the conventional pure Ag is inferior in the reliability of data, this invention persons checked that big-and-rough-izing of a grain or membranous corrosion had the main causes, and found out that the alloying by addition of various elements was effective as the measure.

[0012]That is, in the silver alloy for reflection films of the optical disc of this invention, Cr, Zr, La, Ce, Eu, Ca, Sr, Ba, Ru, nickel, and at least one sort of alloying elements chosen from W are included 0.001 to 0.1weight % to Ag which is a principal component. By raising the heat-resisting property of a silver alloy, these alloying elements serve to suppress big and rough-ization of the grain in a reflection film, and can obtain a high reflectance now stably by the miniaturization of a grain simultaneously. By including these alloying elements, the crystal grain diameter of a target is also miniaturized and the effect that a sputtering rate is equalized is also acquired.

[0013]It is because the corrosion resistance of an alloy will fall and the characteristic degradation of the disk by rewriting etc. will occur, if having made the amount of addition of these elements into 0.001 to 0.1 weight % in total has too low concentration at less than 0.001 weight %, and sufficient addition effect is not acquired

but it exceeds 0.1 weight % conversely. Also when these alloying elements are added combining two or more sorts, it is possible to attain desired characteristics, but the addition effect that the direction which generally crawls and adds a gap or one sort independently is obtained becomes large.
[0014]In addition to the 1st above-mentioned alloying element, at least one sort of 2nd alloying elements chosen from the group which consists of Zn, Mg, Au, and Pd can be included 0.1 to 5weight % as the 2nd form in the silver alloy for reflection films of the optical disc of this invention. In the case of an optical disc provided with the overcoat which has the effect of raising corrosion resistance and contains especially ZnS, these 2nd alloying elements are effective.
[0015]It is because having made the amount of addition of these 2nd alloying elements into 0.1 to 5 weight % has too low concentration at less than 0.1 weight %, and its effect of corrosion-resistant improvement is not enough, and the thermal conductivity of an alloy falls and it becomes impossible to correspond to high storage density-ization of an optical disc, when it exceeds 5 weight % conversely.
[0016]This invention can specify the presentation of the Ag alloy which constitutes a reflection film, and can be similarly specified about the presentation of the sputtering target used for formation of a reflection film.
[0017]The reflection film of the reflector whose high reflectance is [ that the corrosion resistance else / for optical discs / is required ] required for the reflection film of this invention, The use of the reflection film for lights, the reflection film for labels, the reflection film for reflectors, etc., Or heat dissipation nature is also applicable also to a use like reflection films, such as a liquid crystal display (LCD) which becomes important, a plasma display (PDP), and an electro MINESSENSU (EL) display, and also uses, such as various wiring materials with required electrical resistivity being small.
[0018]
[Working example]Ag, Cr, Zr which have 99.9 to 99.999% of purity as a raw material, The target of each sample was produced using the lump or powder of La, Ce, Eu, Ca, Sr, Ba, Ru, nickel, W, Zn, Mg, Au, and Pd with dissolution casting using a vacuum melting furnace, or the powder metallurgy process using a hot press. The presentation of the target in each obtained sample is shown in the following table 1.
[0019]
[Table 1]

| 試料 | ターゲット組成(wt%) | | ターゲット組成(at%) |
|---|---|---|---|
| | 第1添加元素 | 第2添加元素 | |
| 1 | 0.001Zr | − | Ag99.999Zr0.001 |
| 2 | 0.001Ce | − | Ag99.999Ce0.001 |
| 3 | 0.001Ca | − | Ag99.997Ca0.003 |
| 4 | 0.001Ru | − | Ag99.999Ru0.001 |
| 5 | 0.001Sr | − | Ag99.999Sr0.001 |
| 6 | 0.001Ba | − | Ag99.999Ba0.001 |
| 7 | 0.01Cr | − | Ag99.979Cr0.021 |
| 8 | 0.01La | − | Ag99.992La0.008 |
| 9 | 0.1Eu | − | Ag99.929Eu0.071 |
| 10 | 0.1Zr | − | Ag99.882Zr0.118 |
| 11 | 0.1Ce | − | Ag99.923Ce0.077 |
| 12 | 0.1Ca | − | Ag99.731Ca0.269 |
| 13 | 0.1Ru | − | Ag99.893Ru0.107 |
| 14 | 0.001Ni | − | Ag99.998Ni0.002 |
| 15 | 0.1Ni | − | Ag99.816Ni0.184 |
| 16 | 0.001W | − | Ag99.999W0.001 |
| 17 | 0.1W | − | Ag99.941W0.059 |
| 18 | 0.01Ru | 0.5Zn | Ag99.167Ru0.011Zn0.823 |
| 19 | 0.01Ce | 5Zn | Ag92.000Ce0.008Zn7.992 |
| 20 | 0.01Zr | 0.5Mg | Ag97.807Zr0.012Mg2.181 |
| 21 | 0.01Ca | 5Mg | Ag81.049Ca0.023Mg18.929 |
| 22 | 0.1Cr | 0.5Au | Ag99.518Cr0.274Au0.208 |
| 23 | 0.001Cr | 5Au | Ag97.196Cr0.002Au2.802 |
| 24 | 0.1La | 0.5Pd | Ag99.415La0.078Pd0.507 |
| 25 | 0.001La | 5Pd | Ag94.934La0.001Pd5.066 |
| 26 | 0.01W | 5Au | Ag97.192W0.006Au2.802 |
| 27 | 0.01Ni | 5Pd | Ag94.916Ni0.018Pd5.066 |
| 28 | 0.1Sr | 1Zn1Pd | Ag97.239Sr0.122Zn1.638Pd1.001 |
| 29 | 0.1Br | 1Mg1Au | Ag95.082Ba0.076Mg4.310Au0.532 |
| 30 | 0.001Eu | 2Pd2Au | Ag96.849Eu0.001Pd2.045Au1.105 |
| 31 | 0.1W | 3Au2Zn | Ag94.993W0.059Zn3.303Au1.645 |
| 32 | 0.1Ni | 1Mg4Pd | Ag91.625Ni0.177Mg4.284Pd3.914 |
| 33＊ | − | − | Ag |
| 34＊ | 0.3Cr | − | Ag99.38Cr0.62 |
| 35＊ | 0.3La | − | Ag99.922La0.078 |
| 36＊ | 0.1Ca | 7Mg | Ag74.773Ca0.217Mg25.01 |
| 37＊ | 0.1La | 7Pd | Ag92.832La0.078Pd7.090 |

（注）表中の＊を付した試料は比較例である（以下同じ）。

[0020]The 3000-A-thick thin film for characterization was formed on the glass substrate with magnetron sputtering method using each of these targets. It checked by the chemical analysis that the presentation of the formed thin film was almost equivalent to the used target presentation.

[0021]A reflectance, heat conductivity, and grain stability were evaluated using the obtained thin film. That is, about heat conductivity, since it was difficult to carry out direct measurement of the heat conductivity of a thin film, it asked by calculating using a Widemann-Franz rule from the electric resistance measured by the direct-current 4 terminal method, and the result was shown in the following table 2. With the spectrophotometer, measurement of the reflectance was performed at the wavelength 400 and 650 or 780 nm, and showed the result in Table 3.

[0022]

[Table 2]

| 試料 | 反射膜 | 熱伝導率(W／m·K) |
|---|---|---|
| 1 | Ag99.999Zr0.001 | 293.30 |
| 2 | Ag99.999Ce0.001 | 296.25 |
| 3 | Ag99.997Ca0.003 | 295.24 |
| 4 | Ag99.999Ru0.001 | 294.98 |
| 5 | Ag99.999Sr0.001 | 296.95 |
| 6 | Ag99.999Ba0.001 | 297.07 |
| 7 | Ag99.979Cr0.021 | 294.03 |
| 8 | Ag99.992La0.008 | 201.54 |
| 9 | Ag99.929Eu0.071 | 273.75 |
| 10 | Ag99.882Zr0.118 | 259.92 |
| 11 | Ag99.923Ce0.077 | 285.01 |
| 12 | Ag99.731Ca0.269 | 285.05 |
| 13 | Ag99.893Ru0.107 | 273.71 |
| 14 | Ag99.998Ni0.002 | 291.86 |
| 15 | Ag99.816Ni0.184 | 249.02 |
| 16 | Ag99.999W0.001 | 296.84 |
| 17 | Ag99.941W0.059 | 290.59 |
| 18 | Ag99.167Ru0.011Zn0.823 | 237.13 |
| 19 | Ag92.000Ce0.008Zn7.992 | 96.74 |
| 20 | Ag97.807Zr0.012Mg2.181 | 208.47 |
| 21 | Ag81.049Ca0.023Mg18.929 | 72.43 |
| 22 | Ag99.518Cr0.274Au0.208 | 229.44 |
| 23 | Ag97.196Cr0.002Au2.802 | 203.74 |
| 24 | Ag99.415La0.078Pd0.507 | 262.99 |
| 25 | Ag94.934La0.001Pd5.066 | 156.16 |
| 26 | Ag97.192W0.006Au2.802 | 205.62 |
| 27 | Ag94.916Ni0.018Pd5.066 | 148.86 |
| 28 | Ag97.239Sr0.122Zn1.638Pd1.001 | 183.63 |
| 29 | Ag95.082Ba0.076Mg4.310Au0.532 | 165.14 |
| 30 | Ag96.849Eu0.001Pd2.045Au1.105 | 192.70 |
| 31 | Ag94.993W0.059Zn3.303Au1.645 | 139.81 |
| 32 | Ag91.625Ni0.177Mg4.284Pd3.914 | 107.83 |
| 33* | Ag | 297.56 |
| 34* | Ag99.38Cr0.62 | 169.10 |
| 35* | Ag99.922La0.078 | 285.72 |
| 36* | Ag74.773Ca0.217Mg25.01 | 58.14 |
| 37* | Ag92.832La0.078Pd7.090 | 129.21 |

[0023]

[Table 3]

| 試料 | 反射膜 | 反射率(%) | | |
|---|---|---|---|---|
| | | 780(nm) | 650(nm) | 400(nm) |
| 1 | Ag99.999Zr0.001 | 97.9 | 97.7 | 94.2 |
| 2 | Ag99.999Ce0.001 | 97.9 | 97.7 | 94.2 |
| 3 | Ag99.997Ca0.003 | 97.9 | 97.7 | 94.2 |
| 4 | Ag99.999Ru0.001 | 97.9 | 97.7 | 94.2 |
| 5 | Ag99.999Sr0.001 | 97.9 | 97.7 | 94.2 |
| 6 | Ag99.999Ba0.001 | 98.0 | 97.9 | 94.8 |
| 7 | Ag99.979Cr0.021 | 97.5 | 97.3 | 94.5 |
| 8 | Ag99.992La0.008 | 98.0 | 97.9 | 94.8 |
| 9 | Ag99.929Eu0.071 | 98.0 | 97.9 | 94.8 |
| 10 | Ag99.882Zr0.118 | 97.4 | 97.2 | 94.6 |
| 11 | Ag99.923Ce0.077 | 98.0 | 97.9 | 94.8 |
| 12 | Ag99.731Ca0.269 | 97.3 | 97.0 | 94.0 |
| 13 | Ag99.893Ru0.107 | 97.4 | 97.1 | 94.0 |
| 14 | Ag99.998Ni0.002 | 98.0 | 97.9 | 94.8 |
| 15 | Ag99.816Ni0.184 | 97.9 | 97.7 | 94.3 |
| 16 | Ag99.999W0.001 | 98.0 | 97.9 | 94.8 |
| 17 | Ag99.941W0.059 | 98.0 | 97.9 | 94.8 |
| 18 | Ag99.167Ru0.011Zn0.823 | 97.3 | 97.0 | 93.9 |
| 19 | Ag92.000Ce0.008Zn7.992 | 90.2 | 89.9 | 85.9 |
| 20 | Ag97.807Zr0.012Mg2.181 | 92.1 | 91.7 | 88.8 |
| 21 | Ag81.049Ca0.023Mg18.929 | 80.9 | 79.0 | 65.3 |
| 22 | Ag99.518Cr0.274Au0.208 | 97.4 | 97.2 | 94.4 |
| 23 | Ag97.196Cr0.002Au2.802 | 91.9 | 90.1 | 88.2 |
| 24 | Ag99.415La0.078Pd0.507 | 97.4 | 97.2 | 94.3 |
| 25 | Ag94.934La0.001Pd5.066 | 90.3 | 89.9 | 86.0 |
| 26 | Ag97.192W0.006Au2.802 | 91.8 | 90.2 | 88.3 |
| 27 | Ag94.916Ni0.018Pd5.066 | 90.8 | 89.9 | 86.2 |
| 28 | Ag97.239Sr0.122Zn1.638Pd1.001 | 91.6 | 90.1 | 88.5 |
| 29 | Ag95.082Ba0.076Mg4.310Au0.532 | 90.7 | 89.9 | 86.1 |
| 30 | Ag96.849Eu0.001Pd2.045Au1.105 | 91.3 | 89.8 | 88.3 |
| 31 | Ag94.993W0.059Zn3.303Au1.645 | 90.2 | 89.8 | 85.7 |
| 32 | Ag91.625Ni0.177Mg4.284Pd3.914 | 90.2 | 89.7 | 85.7 |
| 33* | Ag | 98.0 | 97.9 | 94.8 |
| 34* | Ag99.38Cr0.62 | 97.5 | 97.2 | 94.1 |
| 35* | Ag99.922La0.078 | 98.0 | 97.9 | 94.8 |
| 36* | Ag74.773Ca0.217Mg25.01 | 74.9 | 71.3 | 63.4 |
| 37* | Ag92.832La0.078Pd7.090 | 91.2 | 89.9 | 87.8 |

[0024]Change of the crystal grain diameter before and after performing heat treatment of 48 hours at 150 ** in a high vacuum was investigated as an index showing the difficulty of happening of big-and-rough-izing of a grain. The result evaluated by surface roughness (center-line-surface-roughness Ra) which measured the calculated value calculated from the X diffraction full width at half maximum with the following table 4 and an atomic force microscope as a crystal grain diameter before and behind heat treatment was shown in the following table 5. It is thought that a crystal grain diameter is large, so that surface roughness is large in the case of Table 5.

[0025]

[Table 4]

| 試料 | 反射膜 | 粒径 L (111)[Å] | |
|---|---|---|---|
| | | 熱処理前 | 熱処理後 |
| 1 | Ag99.999Zr0.001 | 175 | 170 |
| 2 | Ag99.999Ce0.001 | 174 | 171 |
| 3 | Ag99.997Ca0.003 | 176 | 170 |
| 4 | Ag99.999Ru0.001 | 175 | 170 |
| 5 | Ag99.999Sr0.001 | 175 | 171 |
| 6 | Ag99.999Ba0.001 | 175 | 170 |
| 7 | Ag99.979Cr0.021 | 176 | 173 |
| 8 | Ag99.992La0.008 | 176 | 170 |
| 9 | Ag99.929Eu0.071 | 175 | 170 |
| 10 | Ag99.882Zr0.118 | 173 | 170 |
| 11 | Ag99.923Ce0.077 | 174 | 170 |
| 12 | Ag99.731Ca0.269 | 175 | 170 |
| 13 | Ag99.893Ru0.107 | 175 | 170 |
| 14 | Ag99.998Ni0.002 | 176 | 171 |
| 15 | Ag99.816Ni0.184 | 175 | 170 |
| 16 | Ag99.999W0.001 | 174 | 170 |
| 17 | Ag99.941W0.059 | 175 | 170 |
| 18 | Ag99.167Ru0.011Zn0.823 | 155 | 151 |
| 19 | Ag92.000Ce0.008Zn7.992 | 155 | 155 |
| 20 | Ag97.807Zr0.012Mg2.181 | 170 | 170 |
| 21 | Ag81.049Ca0.023Mg18.929 | 170 | 170 |
| 22 | Ag99.518Cr0.274Au0.208 | 160 | 160 |
| 23 | Ag97.196Cr0.002Au2.802 | 160 | 160 |
| 24 | Ag99.415La0.078Pd0.507 | 165 | 165 |
| 25 | Ag94.934La0.001Pd5.066 | 165 | 165 |
| 26 | Ag97.192W0.006Au2.802 | 160 | 160 |
| 27 | Ag94.916Ni0.018Pd5.066 | 165 | 165 |
| 28 | Ag97.239Sr0.122Zn1.638Pd1.001 | 150 | 150 |
| 29 | Ag95.082Ba0.076Mg4.310Au0.532 | 150 | 150 |
| 30 | Ag96.849Eu0.001Pd2.045Au1.105 | 145 | 145 |
| 31 | Ag94.993W0.059Zn3.303Au1.645 | 145 | 145 |
| 32 | Ag91.625Ni0.177Mg4.284Pd3.914 | 145 | 145 |
| 33* | Ag | 165 | 175 |
| 34* | Ag99.38Cr0.62 | 175 | 193 |
| 35* | Ag99.922La0.078 | 175 | 180 |
| 36* | Ag74.773Ca0.217Mg25.01 | 165 | 165 |
| 37* | Ag92.832La0.078Pd7.090 | 165 | 165 |

[0026]

[Table 5]

| 試料 | 反射膜 | 表面粗さRa(Å) | |
|---|---|---|---|
| | | 熱処理前 | 熱処理後 |
| 1 | Ag99.999Zr0.001 | <10 | <10 |
| 2 | Ag99.999Ce0.001 | <10 | <10 |
| 3 | Ag99.997Ca0.003 | <10 | <10 |
| 4 | Ag99.999Ru0.001 | <10 | <10 |
| 5 | Ag99.999Sr0.001 | <10 | <10 |
| 6 | Ag99.999Ba0.001 | <10 | <10 |
| 7 | Ag99.979Cr0.021 | <10 | <10 |
| 8 | Ag99.992La0.008 | <10 | <10 |
| 9 | Ag99.929Eu0.071 | <10 | <10 |
| 10 | Ag99.882Zr0.118 | <10 | <10 |
| 11 | Ag99.923Ce0.077 | <10 | <10 |
| 12 | Ag99.731Ca0.269 | <10 | <10 |
| 13 | Ag99.893Ru0.107 | <10 | <10 |
| 14 | Ag99.998Ni0.002 | <10 | <10 |
| 15 | Ag99.816Ni0.184 | <10 | <10 |
| 16 | Ag99.999W0.001 | <10 | <10 |
| 17 | Ag99.941W0.059 | <10 | <10 |
| 18 | Ag99.167Ru0.011Zn0.823 | <10 | <10 |
| 19 | Ag92.000Ce0.008Zn7.992 | <10 | <10 |
| 20 | Ag97.807Zr0.012Mg2.181 | <10 | <10 |
| 21 | Ag81.049Ca0.023Mg18.929 | <10 | <10 |
| 22 | Ag99.518Cr0.274Au0.208 | <10 | <10 |
| 23 | Ag97.196Cr0.002Au2.802 | <10 | <10 |
| 24 | Ag99.415La0.078Pd0.507 | <10 | <10 |
| 25 | Ag94.934La0.001Pd5.066 | <10 | <10 |
| 26 | Ag97.192W0.006Au2.802 | <10 | <10 |
| 27 | Ag94.916Ni0.018Pd5.066 | <10 | <10 |
| 28 | Ag97.239Sr0.122Zn1.638Pd1.001 | <10 | <10 |
| 29 | Ag95.082Ba0.076Mg4.310Au0.532 | <10 | <10 |
| 30 | Ag96.849Eu0.001Pd2.045Au1.105 | <10 | <10 |
| 31 | Ag94.993W0.059Zn3.303Au1.645 | <10 | <10 |
| 32 | Ag91.625Ni0.177Mg4.284Pd3.914 | <10 | <10 |
| 33* | Ag | <10 | 23 |
| 34* | Ag99.38Cr0.62 | 10 | 11 |
| 35* | Ag99.922La0.078 | 10 | 10 |
| 36* | Ag74.773Ca0.217Mg25.01 | <10 | 10 |
| 37* | Ag92.832La0.078Pd7.090 | <10 | 10 |

[0027]Even if a reflectance and heat conductivity are high and it moreover receives heat from the above result by using the silver alloy of this invention, it turns out that the reflection film of outstanding characteristics in which big and rough-ization of a grain does not take place easily can be obtained.
[0028]Next, the disk characteristics at the time of using the reflection film of this invention for an optical disc were evaluated. That is, two kinds of substrates made from polycarbonate, 0.6-mm [ in thickness ], 120-mm [ in diameter ], and slot pitch 0.8micrometer and the substrate for DVD with a channel depth of 35 nm, were used as the substrate 1 as 1.2-mm [ in thickness ], 120-mm [ in diameter ], and slot (track) pitch 1.6micrometer, the substrate for CD with a channel depth of 50 nm, and the substrate 2.
[0029]The evaluation disk for CD was obtained by forming the overcoat layer of ultraviolet curing resin in a thickness of 5 micrometers, after forming a lower overcoat, record film, a top overcoat, a diffusion preventing film, and a reflection film one by one by sputtering on the above-mentioned substrate 1. Similarly the evaluation disk for DVD on the above-mentioned substrate 2 A lower overcoat, After forming record film, a top overcoat, a diffusion preventing film, a reflection film, and a 4-micrometer-thick overcoat layer one by one, it produced by pasting together a polycarbonate board 0.6 mm in thickness, and 120 mm in diameter with ultraviolet curing resin on it. The thickness of the following table 7 and each film was shown for the composition of each disk sample which produced the sputtering condition used for film formation with the material of each of above-mentioned films to the following table 6 in the following table 8.

[0030]

[Table 6]

| 膜 | 材料系 | 投入電力 (kW) | ガス圧 (mTorr) | その他の条件 |
|---|---|---|---|---|
| 保護膜 | ZnS+SiO$_2$系 | RF4.0 | 6 | |
| 拡散防止膜 | SiNx | DC2.0 | 3 | Siターゲット使用 N$_2$との反応スパッタ |
| | Ta$_2$O$_5$ | RF4.0 | 6 | |
| | ZrO$_2$ | RF4.0 | 6 | |
| | AlN | RF4.0 | 6 | |
| | SiC | RF4.0 | 6 | |
| 記録膜 | AgInSbTe系 | DC0.5 | 3 | |
| 反射膜 | Ag合金 | DC1.0 | 3 | |

[0031]

[Table 7]

| 試料 | 反射膜 | 保護膜 | 拡散防止膜 | 基板 |
|---|---|---|---|---|
| 1 | Ag99.999Zr0.001 | (ZnS)80(SiO$_2$)20 | AlN | 1 |
| 2 | Ag99.999Ce0.001 | (ZnS)80(SiO$_2$)20 | AlN | 1 |
| 3 | Ag99.997Ca0.003 | (ZnS)80(SiO$_2$)20 | AlN | 2 |
| 4 | Ag99.999Ru0.001 | (ZnS)80(SiO$_2$)20 | AlN | 1 |
| 5 | Ag99.999Sr0.001 | (ZnS)80(SiO$_2$)20 | AlN | 2 |
| 6 | Ag99.999Ba0.001 | (ZnS)80(SiO$_2$)20 | AlN | 1 |
| 7 | Ag99.979Cr0.021 | (ZnS)80(SiO$_2$)20 | AlN | 2 |
| 8 | Ag99.992La0.008 | (ZnS)80(SiO$_2$)20 | AlN | 2 |
| 9 | Ag99.929Eu0.071 | (ZnS)80(SiO$_2$)20 | AlN | 2 |
| 10 | Ag99.882Zr0.118 | (ZnS)80(SiO$_2$)20 | SiC | 1 |
| 11 | Ag99.923Ce0.077 | (ZnS)80(SiO$_2$)20 | SiC | 1 |
| 12 | Ag99.731Ca0.269 | (ZnS)80(SiO$_2$)20 | SiC | 1 |
| 13 | Ag99.893Ru0.107 | (ZnS)80(SiO$_2$)20 | SiC | 2 |
| 14 | Ag99.998Ni0.002 | (ZnS)80(SiO$_2$)20 | SiC | 2 |
| 15 | Ag99.816Ni0.184 | (ZnS)80(SiO$_2$)20 | SiC | 1 |
| 16 | Ag99.999W0.001 | (ZnS)80(SiO$_2$)20 | SiC | 1 |
| 17 | Ag99.941W0.059 | (ZnS)80(SiO$_2$)20 | SiC | 1 |
| 18 | Ag99.167Ru0.011Zn0.823 | (ZnS)80(SiO$_2$)20 | SiNx | 2 |
| 19 | Ag92.000Ce0.008Zn7.992 | (ZnS)80(SiO$_2$)20 | – | 2 |
| 20 | Ag97.807Zr0.012Mg2.181 | (ZnS)80(SiO$_2$)20 | Ta$_2$O$_5$ | 2 |
| 21 | Ag81.049Ca0.023Mg18.929 | (ZnS)80(SiO$_2$)20 | – | 2 |
| 22 | Ag99.518Cr0.274Au0.208 | (ZnS)80(SiO$_2$)20 | AlN | 1 |
| 23 | Ag97.196Cr0.002Au2.802 | (ZnS)80(SiO$_2$)20 | SiNx | 1 |
| 24 | Ag99.415La0.078Pd0.507 | (ZnS)80(SiO$_2$)20 | ZrO$_2$ | 1 |
| 25 | Ag94.934La0.001Pd5.066 | (ZnS)80(SiO$_2$)20 | – | 2 |
| 26 | Ag97.192W0.006Au2.802 | (ZnS)80(SiO$_2$)20 | – | 2 |
| 27 | Ag94.916Ni0.018Pd5.066 | (ZnS)80(SiO$_2$)20 | – | 2 |
| 28 | Ag97.239Sr0.122Zn1.638Pd1.001 | (ZnS)80(SiO$_2$)20 | – | 1 |
| 29 | Ag95.082Ba0.076Mg4.310Au0.532 | (ZnS)80(SiO$_2$)20 | – | 2 |
| 30 | Ag96.849Eu0.001Pd2.045Au1.105 | (ZnS)80(SiO$_2$)20 | – | 1 |
| 31 | Ag94.993W0.059Zn3.303Au1.645 | (ZnS)80(SiO$_2$)20 | – | 2 |
| 32 | Ag91.625Ni0.177Mg4.284Pd3.914 | (ZnS)80(SiO$_2$)20 | – | 2 |
| 33* | Ag | (ZnS)80(SiO$_2$)20 | SiNx | 1 |
| 34* | Ag99.38Cr0.62 | (ZnS)80(SiO$_2$)20 | Ta$_2$O$_5$ | 2 |
| 35* | Ag99.922La0.078 | (ZnS)80(SiO$_2$)20 | SiC | 2 |
| 36* | Ag74.773Ca0.217Mg25.01 | (ZnS)80(SiO$_2$)20 | – | 1 |
| 37* | Ag92.832La0.078Pd7.090 | (ZnS)80(SiO$_2$)20 | – | 2 |

[0032]

[Table 8]

| 試料 | 下部保護膜 (nm) | 記録膜 (nm) | 上部保護膜 (nm) | 拡散防止膜 (nm) | 反射膜 (nm) |
|---|---|---|---|---|---|
| 1 | 85 | 17.5 | 35 | 5 | 100 |
| 2 | 85 | 17.5 | 34 | 5 | 100 |
| 3 | 80 | 17.0 | 25 | 5 | 160 |
| 4 | 85 | 17.5 | 35 | 5 | 120 |
| 5 | 80 | 17.0 | 25 | 5 | 160 |
| 6 | 87 | 17.5 | 34 | 5 | 120 |
| 7 | 79 | 17.0 | 25 | 5 | 160 |
| 8 | 80 | 17.0 | 26 | 5 | 160 |
| 9 | 81 | 17.0 | 25 | 5 | 160 |
| 10 | 84 | 17.5 | 35 | 5 | 100 |
| 11 | 86 | 17.5 | 34 | 5 | 120 |
| 12 | 85 | 17.5 | 35 | 5 | 100 |
| 13 | 80 | 17.0 | 25 | 5 | 160 |
| 14 | 80 | 17.0 | 25 | 5 | 160 |
| 15 | 84 | 17.5 | 36 | 5 | 100 |
| 16 | 85 | 17.5 | 34 | 5 | 100 |
| 17 | 85 | 17.5 | 34 | 5 | 100 |
| 18 | 80 | 17.0 | 25 | 5 | 170 |
| 19 | 80 | 17.0 | 25 | — | 170 |
| 20 | 80 | 17.0 | 25 | 5 | 170 |
| 21 | 80 | 17.0 | 25 | — | 160 |
| 22 | 85 | 17.5 | 35 | 5 | 100 |
| 23 | 85 | 17.5 | 34 | 5 | 120 |
| 24 | 85 | 17.5 | 34 | 5 | 110 |
| 25 | 80 | 17.0 | 25 | — | 160 |
| 26 | 80 | 17.0 | 25 | — | 160 |
| 27 | 80 | 17.0 | 25 | — | 160 |
| 28 | 85 | 17.5 | 34 | — | 100 |
| 29 | 80 | 17.0 | 25 | — | 160 |
| 30 | 85 | 17.5 | 34 | — | 100 |
| 31 | 80 | 17.0 | 25 | — | 160 |
| 32 | 80 | 17.0 | 25 | — | 160 |
| 33* | 85 | 17.5 | 34 | 5 | 110 |
| 34* | 79 | 17.0 | 27 | 5 | 170 |
| 35* | 80 | 17.0 | 25 | 5 | 160 |
| 36* | 85 | 17.5 | 35 | — | 100 |
| 37* | 80 | 17.0 | 25 | — | 160 |

[0033]As evaluation of each disk obtained as mentioned above, a carrier versus the noise ratio (CNR), the jitter, and the modulation factor were measured. In the case of the evaluation disk for CD, it measured by narrowing down and irradiating the diameter of a spot of 1 micrometer with a laser beam with a wavelength of 780 nm through the lens of NA0.55. Linear velocity was made into 2.0 and 3 [ 5.0 or 10.0 m/sec ] levels. In the case of the evaluation disk for DVD, it measured by narrowing down and irradiating the diameter of a spot of 0.5 micrometer with a laser beam with a wavelength of 633 nm through the lens of NA0.6. Linear velocity was made into 2 [ 7.0 or 15.0 m/sec ] levels.

[0034]When laser power (power for Pe:elimination, Pw: power for writing) was fixed to Pe/Pw=0.5 with each linear velocity in any case and it changed Pw with 8-16 mW, CNR is large and the jitter measured by choosing the conditions which become and become small. The laser power of reading used 0.9 mW. Although the record film after film production was amorphous, the examination is presented where the whole disk surface is crystallized by 10-mW DC light.

[0035]After keeping it to 80 **85% RH of high-humidity/temperature tub for 500 hours in order to check the reliability of a disk, measurement of disk characteristics was performed like the above. The test result of the disk characteristics of the back before high-humidity/temperature storage, i.e., CNR, a jitter, and a modulation factor was shown in the following table 9.

[0036]

[Table 9]

| 試料 | 反射膜組成(wt%) | | ディスク特性 | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 第1添加元素 | 第2添加元素 | CNR(dB) | | ジッター(%) | | 変調度(%) | |
| | | | 前 | 後 | 前 | 後 | 前 | 後 |
| 1 | 0.001Zr | − | 55.1 | 54.3 | 6.7 | 8.4 | 73.2 | 70.3 |
| 2 | 0.001Ce | − | 55.0 | 54.8 | 6.9 | 8.3 | 72.1 | 69.3 |
| 3 | 0.001Ca | − | 49.3 | 48.7 | 9.2 | 10.4 | 65.7 | 64.9 |
| 4 | 0.001Ru | − | 54.3 | 53.8 | 6.6 | 8.4 | 69.2 | 69.0 |
| 5 | 0.001Sr | − | 49.5 | 48.0 | 9.3 | 10.5 | 62.7 | 61.9 |
| 6 | 0.001Ba | − | 54.8 | 54.0 | 7.1 | 8.0 | 71.3 | 70.1 |
| 7 | 0.01Cr | − | 49.5 | 48.3 | 9.5 | 10.6 | 63.8 | 61.8 |
| 8 | 0.01La | − | 49.2 | 48.1 | 10.3 | 11.2 | 64.3 | 62.0 |
| 9 | 0.1Eu | − | 48.6 | 47.9 | 10.2 | 11.3 | 62.6 | 61.9 |
| 10 | 0.1Zr | − | 56.2 | 54.9 | 7.7 | 8.9 | 68.2 | 66.3 |
| 11 | 0.1Ce | − | 54.6 | 53.8 | 7.5 | 8.8 | 70.2 | 68.5 |
| 12 | 0.1Ca | − | 53.0 | 52.6 | 7.4 | 8.5 | 68.5 | 67.2 |
| 13 | 0.1Ru | − | 49.1 | 47.5 | 9.9 | 10.7 | 61.7 | 61.6 |
| 14 | 0.001Ni | − | 49.5 | 48.2 | 10.4 | 11.3 | 63.9 | 61.3 |
| 15 | 0.1Ni | − | 49.9 | 49.4 | 7.3 | 8.7 | 69.4 | 97.6 |
| 16 | 0.001W | − | 55.9 | 54.9 | 6.9 | 8.1 | 72.7 | 70.0 |
| 17 | 0.1W | − | 55.8 | 54.7 | 6.9 | 8.4 | 70.1 | 69.4 |
| 18 | 0.01Ru | 0.5Zn | 49.4 | 49.5 | 9.2 | 10.4 | 65.7 | 64.9 |
| 19 | 0.01Ce | 5Zn | 49.5 | 49.3 | 9.4 | 10.4 | 67.6 | 68.2 |
| 20 | 0.01Zr | 0.5Mg | 49.7 | 49.5 | 9.8 | 10.8 | 68.2 | 68.7 |
| 21 | 0.01Ca | 5Mg | 48.6 | 48.3 | 10.5 | 11.4 | 64.6 | 65.3 |
| 22 | 0.1Cr | 0.5Au | 55.1 | 53.9 | 6.9 | 8.1 | 74.4 | 74.3 |
| 23 | 0.001Cr | 5Au | 54.9 | 54.8 | 6.9 | 8.4 | 69.8 | 69.4 |
| 24 | 0.1La | 0.5Pd | 56.2 | 55.8 | 7.3 | 8.5 | 77.6 | 77.5 |
| 25 | 0.001La | 5Pd | 49.9 | 59.7 | 10.3 | 11.2 | 65.8 | 66.2 |
| 26 | 0.01W | 5Au | 50.1 | 49.9 | 10.3 | 11.2 | 66.5 | 66.9 |
| 27 | 0.01Ni | 5Pd | 50.0 | 49.6 | 9.2 | 10.4 | 73.7 | 76.9 |
| 28 | 0.1Sr | 1Zn1Pd | 54.4 | 53.7 | 6.9 | 8.4 | 76.9 | 75.5 |
| 29 | 0.1Br | 1Mg1Au | 48.8 | 47.9 | 9.9 | 10.3 | 64.7 | 62.4 |
| 30 | 0.001Eu | 2Pd2Au | 56.1 | 55.6 | 7.8 | 8.7 | 75.4 | 75.9 |
| 31 | 0.1W | 3Au2Zn | 48.2 | 47.1 | 9.7 | 10.4 | 62.4 | 60.9 |
| 32 | 0.1Ni | 1Mg4Pd | 49.2 | 47.3 | 9.3 | 10.5 | 63.2 | 61.9 |
| 33* | − | − | 50.3 | 44.3 | 9.8 | 18.3 | 77.9 | 55.7 |
| 34* | 0.3Cr | − | 46.2 | 42.4 | 14.5 | 16.9 | 66.3 | 57.5 |
| 35* | 0.3La | − | 46.1 | 42.7 | 14.5 | 18.8 | 66.2 | 58.3 |
| 36* | 0.1Ca | 7Mg | 50.1 | 44.2 | 9.8 | 18.6 | 75.9 | 55.4 |
| 37* | 0.1La | 7Pd | 47.6 | 44.5 | 12.4 | 16.9 | 56.5 | 54.8 |

[0037]As for the reflection film using the silver alloy of this invention, it turns out that it not only has good initial characteristics, but CNR, a jitter, and a modulation factor hardly deteriorate also after high-humidity/temperature storage, but it can obtain a reliable disk so that clearly from Table 9. On the other hand, since initial characteristics with a good disk of the samples 33-37 which are comparative examples are not acquired, or either CRN, a jitter and a modulation factor deteriorate greatly after keeping it with high-humidity/temperature, it turns out that sufficient reliability is not securable.
[0038]The above result shows that especially the Ag alloy of this invention is suitable as a reflection film of an optical disc as an object for the optical discs of the next generation called for from now on. Although the reflection film was produced by the sputtering method in the above-mentioned embodiment, it can create also with various membrane formation art, such as various vacuum deposition methods, the ion plating method, various CVD methods, and an electroplating method.
[0039]
[Effect of the Invention]According to this invention, while it has high thermal conductivity, the reliability of high data can be secured and the silver alloy for reflection films suitable as an object for optical recording disks corresponding to high storage density can be provided.

[Translation done.]